An Arbitrary-Lagrangian-Eulerian code for general polygonal mesh: ALE INC.

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In this work we have developed a 2D unstructured Arbitrary-Lagrangian-Eulerian code. This code is devoted to solve CFD problems for general polygonal meshes with fixed connectivity. Main components of the method are:

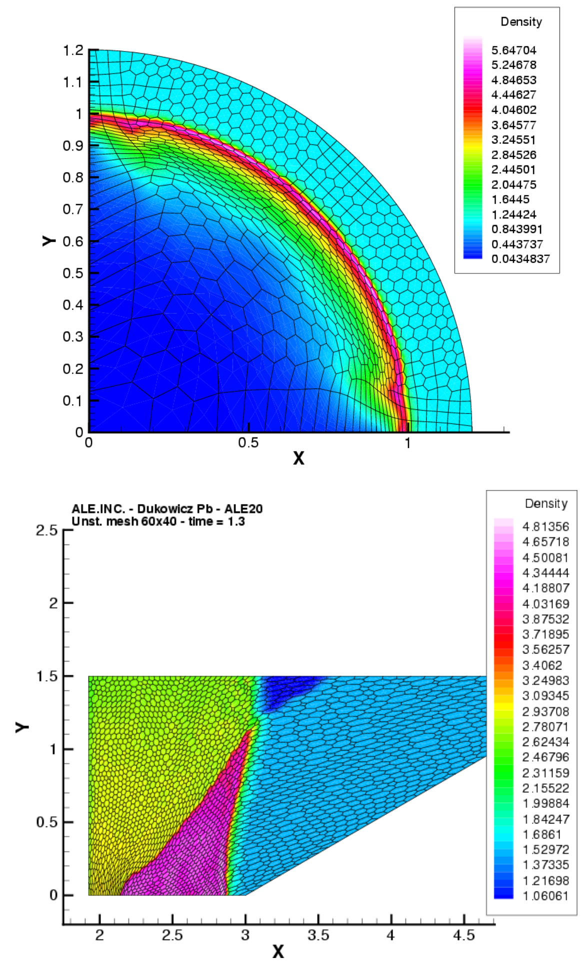
I- a *Lagrangian scheme*. Each polygon is split into subcells. The compatible Lagrangian hydrodynamics equations are solved during one time step and the mesh is moved according to the fluid velocity - see [7], [8], [5] [6].

II- an *Untangling process* which ensures the validity of the mesh, if the mesh was tangled as a result of the Lagrangian step. The method finds an untangled mesh which is as close as possible to the previous Lagrangian grid - see [4], [3], [9].

III- a *Reference Rezone Jacobian Strategy* which improves the quality of the untangled mesh and, at the same time, requires the new mesh to be close to the original untangled grid (from step II) and preserves interfaces between materials - see [2].

IV- a *Remapping method* which gives the linear and bound preserving remapped hydrodynamics variables on the new mesh - see [1], [10].

These four steps have been adapted to the subcell description of the scheme and the polygonal meshes. The untangling and the reference rezone Jacobian processes deal now with general polygonal meshes and preserve the interfaces between materials. The remapping step is performed from a subcell point of view and the accuracy of the remapping stage has been improved with new techniques from [11].
ALE INC. can be used as a purely Lagrangian code (only step I is used), an ALE one (x Lagrangian steps are performed then steps II,III,IV are activated) or as an Eulerian one (steps I and IV



Top: *Sedov blastwave density at* $t = 1.0$ *and final polygonal grid.* ***Bottom*** *Dukowicz problem, polygonal mesh, density and mesh at* $t = 1.3$.

are used and the remapping is done on the same initial grid).

Some examples of simulations using ALE INC. code are presented for an ALE regime for

- the Sedov blastwave problem solved with a polygonal grid, the density and the mesh are presented,
- the Dukowicz problem solved with a polygonal mesh, the density and the mesh are presented,
- the Triple point problem. This simulates the interaction between a planar shock wave and an heavy corner shape obstacle, the density (isolines) and the mesh are presented.

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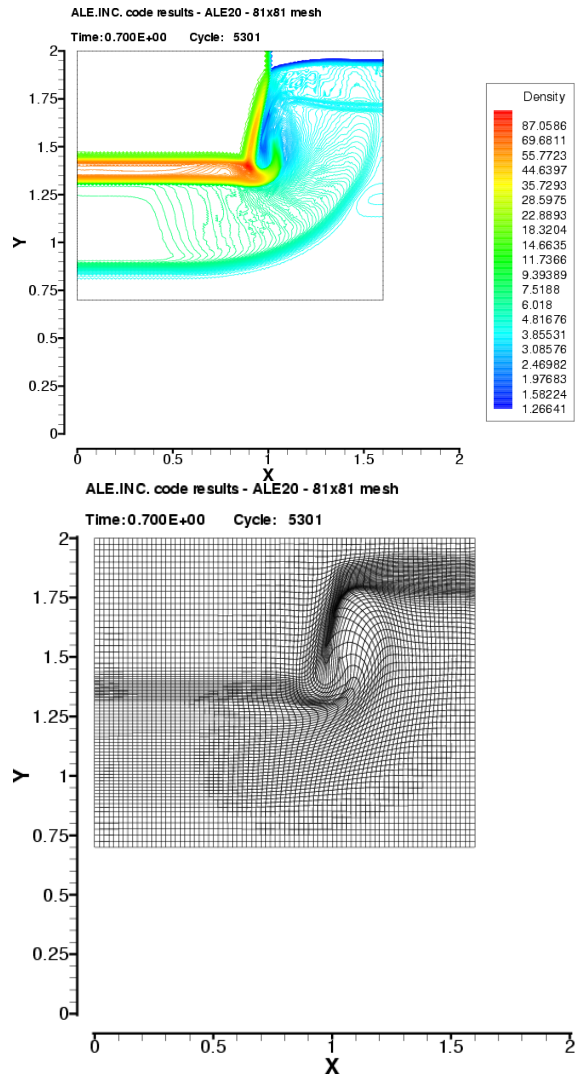

Triple point problem - Uniform logical rectangular grids - 81 × 81 - final density contours (top - Exponential scale) and final mesh (bottom)

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